|  |  |
| --- | --- |
| A picture containing text, whiteboard  Description automatically generated | Text  Description automatically generated with medium confidence |

Text

Description automatically generated with medium confidence

Find eq. pt.

Find:

This is an objective minimization problem.

One can use fmincon matlab function for that purpose.

Furthermore, if one has additional constraints on the input or on the output signals the objective function can have the form of

When the first input control signal needs to be close to 5 and the second output signal needs to be close to 10.

Example:

|  |  |
| --- | --- |
| A picture containing text, whiteboard  Description automatically generated | Text  Description automatically generated with medium confidence |

Text

Description automatically generated with medium confidence

And the explicit representation of the nonlinear dynamical system is given by

Text, letter

Description automatically generated

Notice there are 3 state signals , 2 input signals.

For this example output signals are given by

And it can be directly represented as

First pair needs to be determined.

Additionally we do not have any additional input and output signal related constraints.

Therefore the problem can be explicitly represented as

Let us gather all of the decision variables in a single vector and call it to simplify the representation of the problem and that could facilitate the coding process.

|  |  |
| --- | --- |
| Where, terms are the parameter values which are constant. For this problem, matrices are considered as the parameters of the nonlinear dynamical system. | Text  Description automatically generated |

Then use the following to obtain eq-pts.

A picture containing chart

Description automatically generated

There are 5 decision variables. And as a starting point a vector composed of ones has been chosen. [this is an arbitrary choice, if you have additional info on the system you can select another starting point for this type of optimization problem]

|  |  |
| --- | --- |
|  |  |
|  |

Then,

|  |  |
| --- | --- |
| Additionally, and matrices have been given in the problem.  Obtain the linear dynamical system |  |

One can check,

1. Pole locations
2. Zero locations
3. Stability
4. Controllability
5. Observability
6. Stabilizability
7. Detectability
8. Passivity

Properties of that linear dynamical system.

Design a controller based on that linear system.

[K,CL,gamma,info] = mixsyn(plant,W1,W1,eye(2))

Where the filter,

Text

Description automatically generated

Obtain the controller.

Test the controller on the original nonlinear dynamical system.

Diagram

Description automatically generated

It can be done in Simulink. If the controller works on the nonlinear system under some small disturbances, it can be concluded that the nonlinear system can be stabilized using the designed controller.